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(54) ORGANIC LIGHT EMITTING DISPLAY DEVICE AND METHOD OF REPAIRING THE SAME

(71) Applicant: **SAMSUNG DISPLAY CO., LTD.**, Yongin, Gyeonggi-Do (KR)

(72) Inventors: **Tae Gon Kim**, Cheonan-si (KR); **Sung Ho Cho**, Seoul (KR); **Yong Chul Kim**, Seoul (KR); **Ji Yong Park**, Yongin-si (KR); **Dong-Yoon So**, Asan-si (KR); **Mi Jin Yoon**, Daegu (KR)

(73) Assignee: **SAMSUNG DISPLAY CO., LTD.**, Yongin, Gyeonggi-do (KR)

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H01L 27/32 (2006.01)

(52) **U.S. Cl.**
CPC ***H01L 27/3276*** (2013.01); ***H01L 27/3223*** (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

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Primary Examiner — Whitney T Moore
Assistant Examiner — Scott R Wilson
(74) *Attorney, Agent, or Firm* — Lee & Morse, P.C.

(57) **ABSTRACT**

An organic light emitting display device includes a substrate including a display area and a non-display area, a plurality of scan lines extended in a first direction on the substrate, a plurality of data lines extended in a second direction intersecting the first direction, a plurality of first switching elements in the display area, the plurality of first switching elements being connected to the scan lines and data lines, organic emission layers connected to the first switching elements, first dummy lines between corresponding adjacent ones of the plurality of scan lines, the first dummy lines extending in the first direction, second switching elements disposed in the non-display area, the second switching elements being adjacent to first ends of the first dummy lines, and second dummy lines extended in the second direction, the second dummy lines being adjacent to the second switching elements.

20 Claims, 7 Drawing Sheets

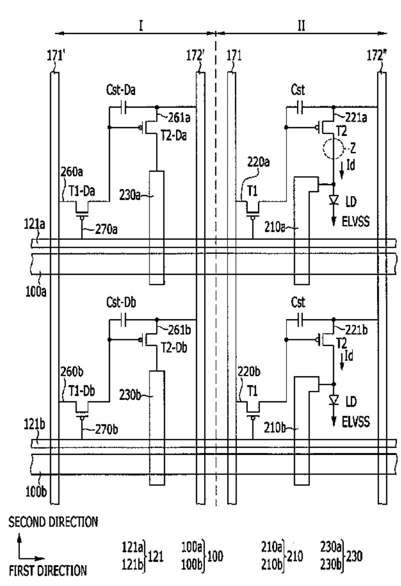
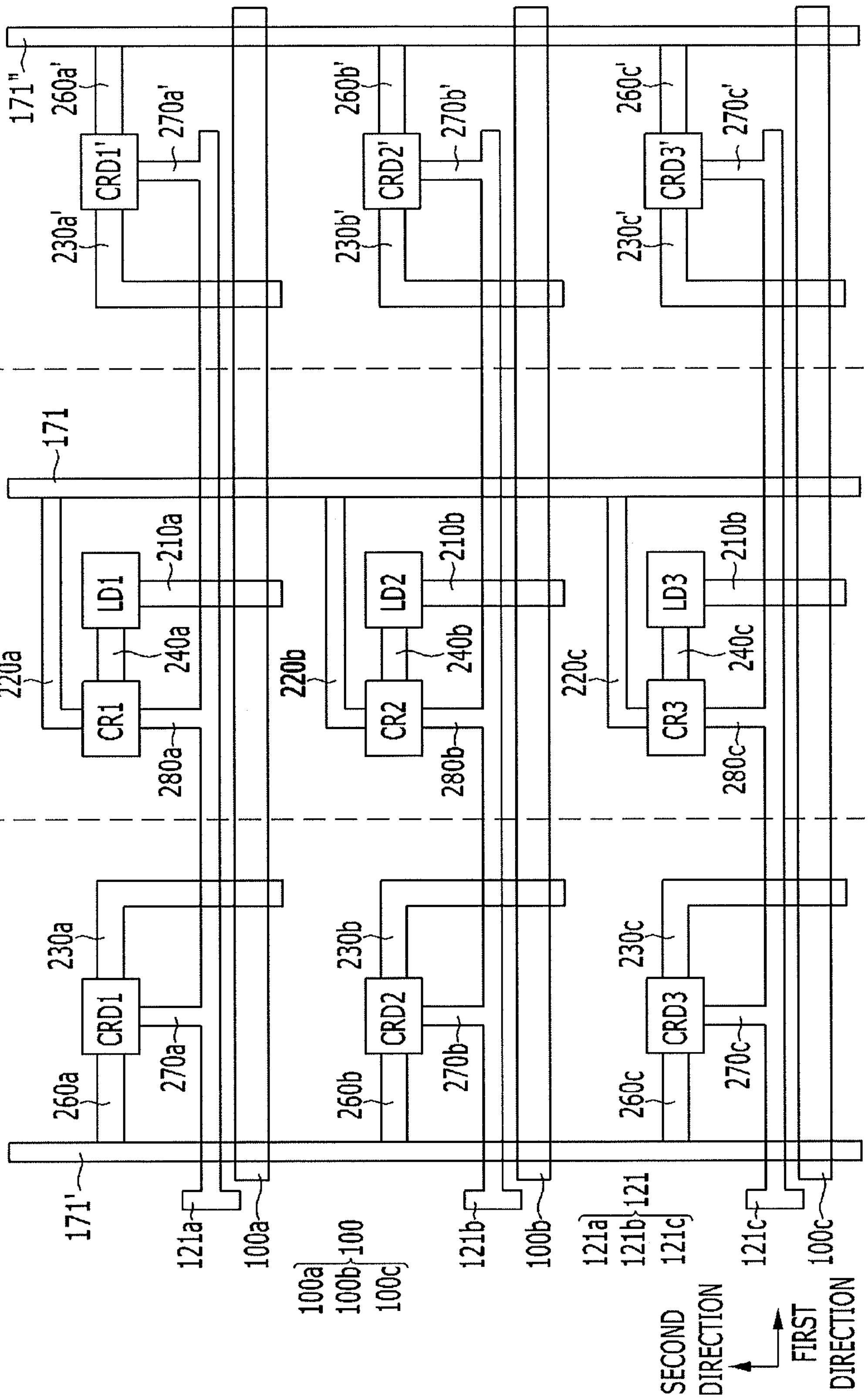


FIG. 1


I
II
III
171'
171
171"
CRD1
CRD2
CRD3
CRD1'
CRD2'
CRD3'
CR1
CR2
CR3
LD1
LD2
LD3
260a
260b
260c
260a'
260b'
260c'
270a
270b
270c
270a'
270b'
270c'
230a
230b
230c
230a'
230b'
230c'
220a
220b
220c
240a
240b
240c
210a
210b
210b
280a
280b
280c
121a
121b
121c
100a
100b
100c
100a
100b
100c
100
121a
121b
121c
121
SECOND DIRECTION
FIRST DIRECTION

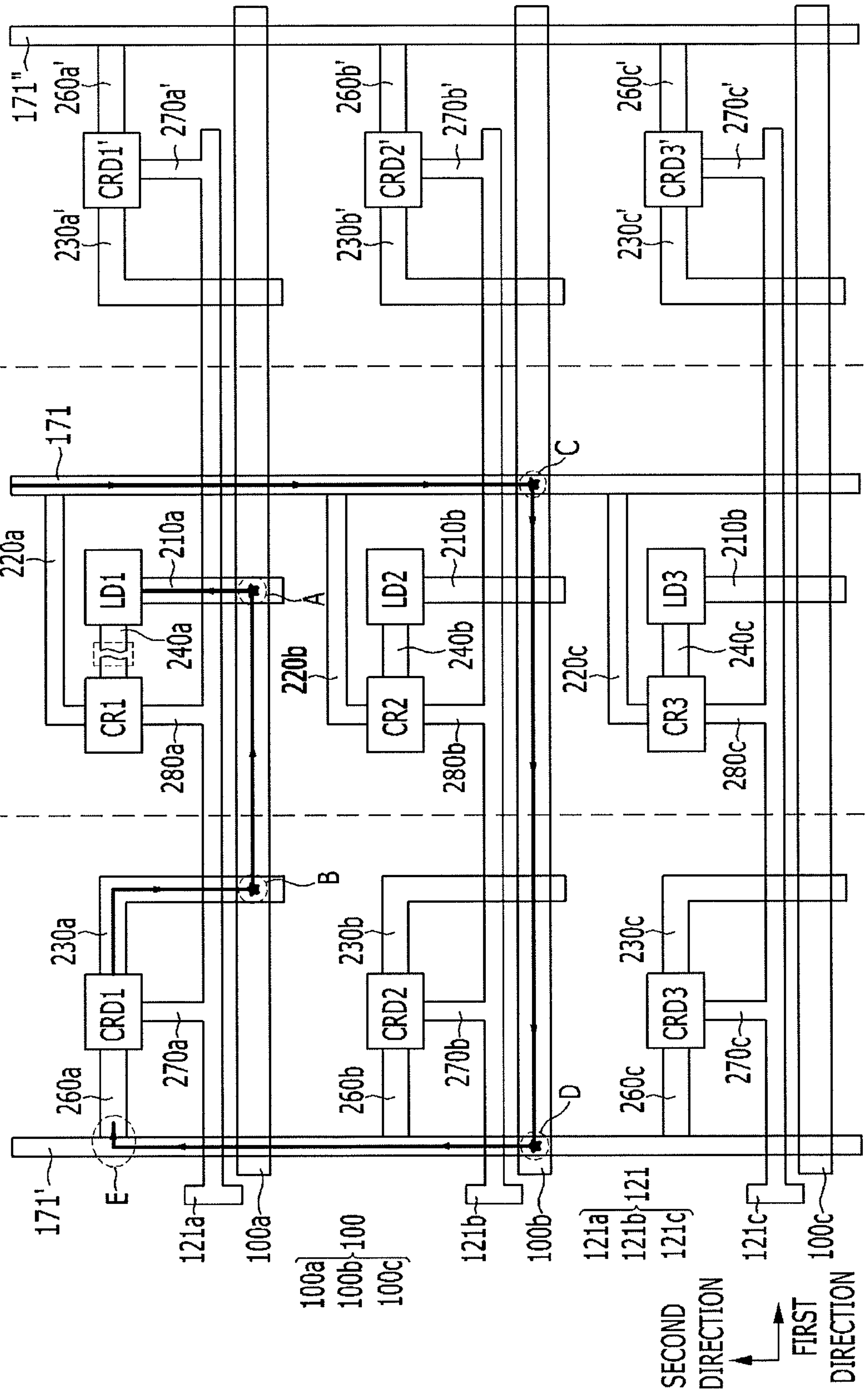

I
II
III
171''
260a'
270a'
CRD1'
230a'
260b'
270b'
CRD2'
230b'
260c'
270c'
CRD3'
230c'
171
220a
LD1
210a
240a
CR1
280a
A
C
220b
LD2
210b
240b
CR2
280b
220c
LD3
210b
240c
CR3
280c
B
230a
CRD1
270a
260a
230b
CRD2
270b
260b
230c
CRD3
270c
260c
D
E
171'
121a
100a
100a
100b
100c
100
121b
100b
121a
121b
121c
121
121c
100c
SECOND DIRECTION
FIRST DIRECTION

FIG. 2

FIG. 3

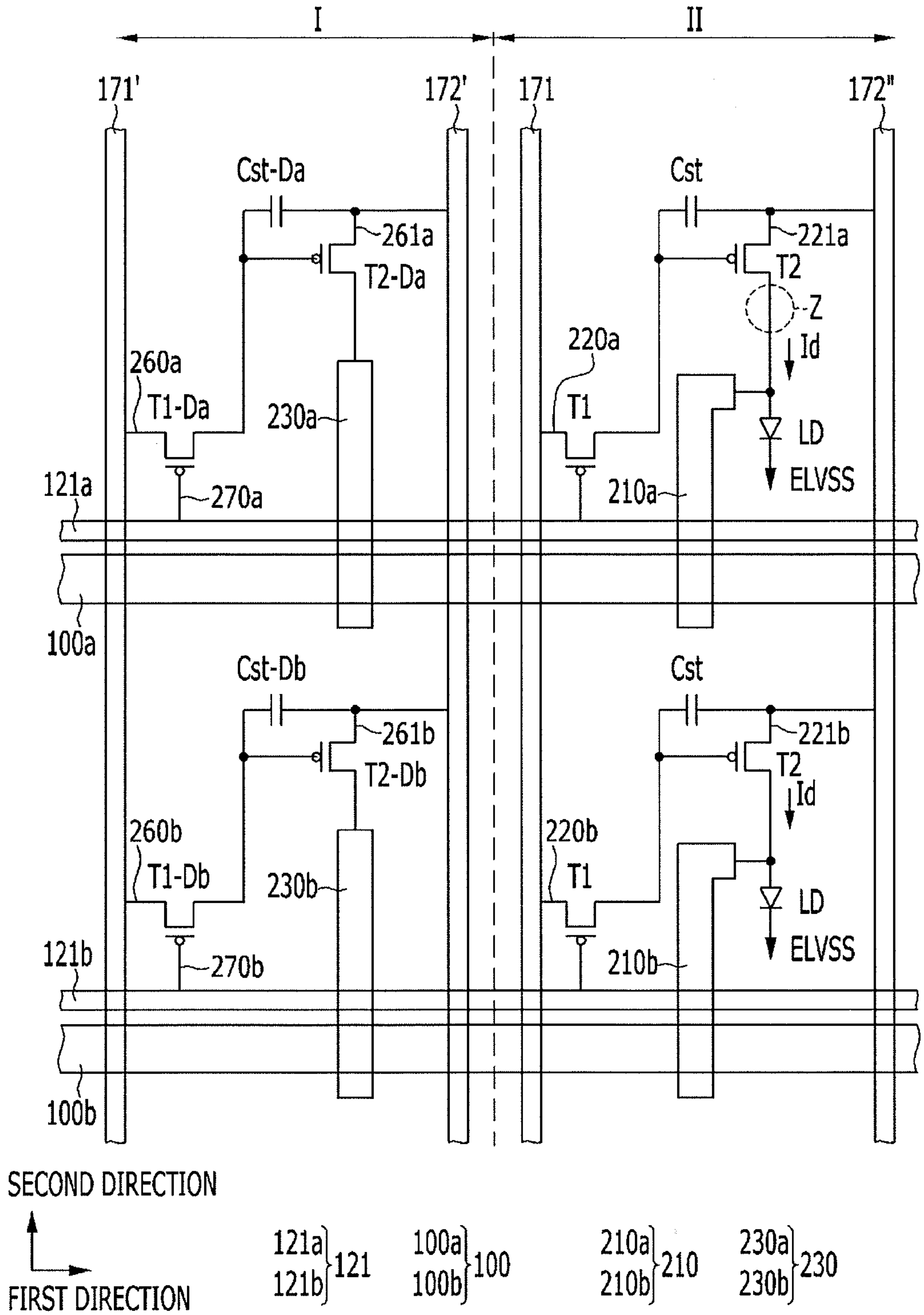
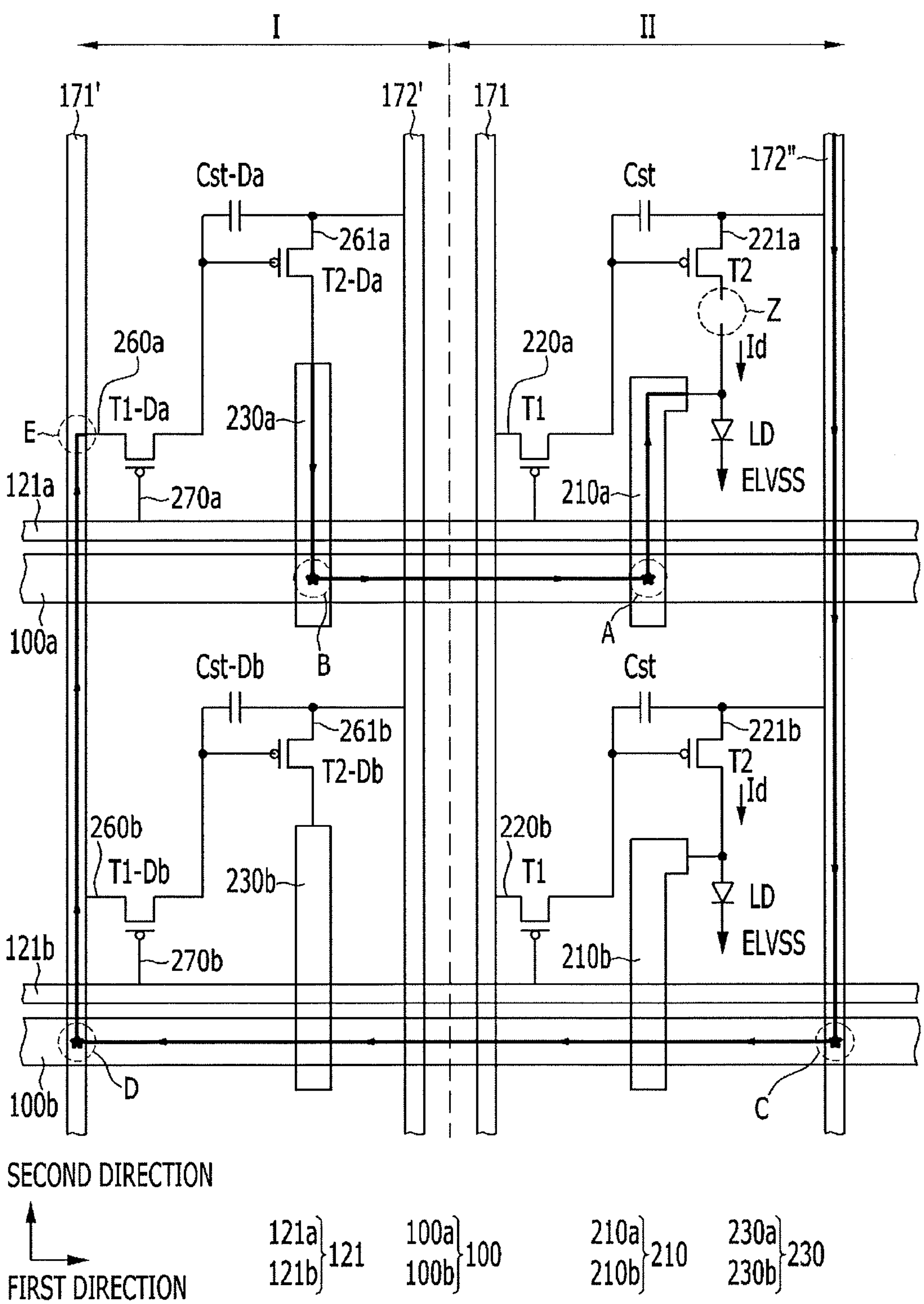

I
II
171'
172'
171
172"
Cst-Da
261a
T2-Da
260a
T1-Da
230a
270a
Cst
221a
T2
Z
Id
220a
T1
LD
ELVSS
210a
121a
100a
Cst-Db
261b
T2-Db
260b
T1-Db
230b
270b
Cst
221b
T2
Id
220b
T1
LD
ELVSS
210b
121b
100b
SECOND DIRECTION
FIRST DIRECTION
121a
121b
121
100a
100b
100
210a
210b
210
230a
230b
230

FIG. 4



I
II
171'
172'
171
172"
Cst-Da
261a
T2-Da
260a
T1-Da
230a
E
270a
121a
100a
B
Cst
221a
T2
Z
Id
220a
T1
LD
ELVSS
210a
A
Cst-Db
261b
T2-Db
260b
T1-Db
230b
270b
121b
100b
D
Cst
221b
T2
Id
220b
T1
LD
ELVSS
210b
C
SECOND DIRECTION
FIRST DIRECTION
121a
121b
121
100a
100b
100
210a
210b
210
230a
230b
230

FIG. 5

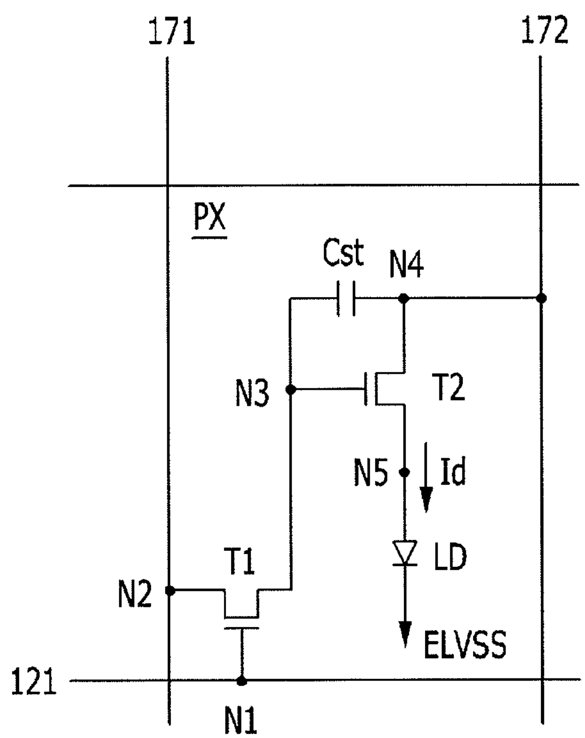


FIG. 6

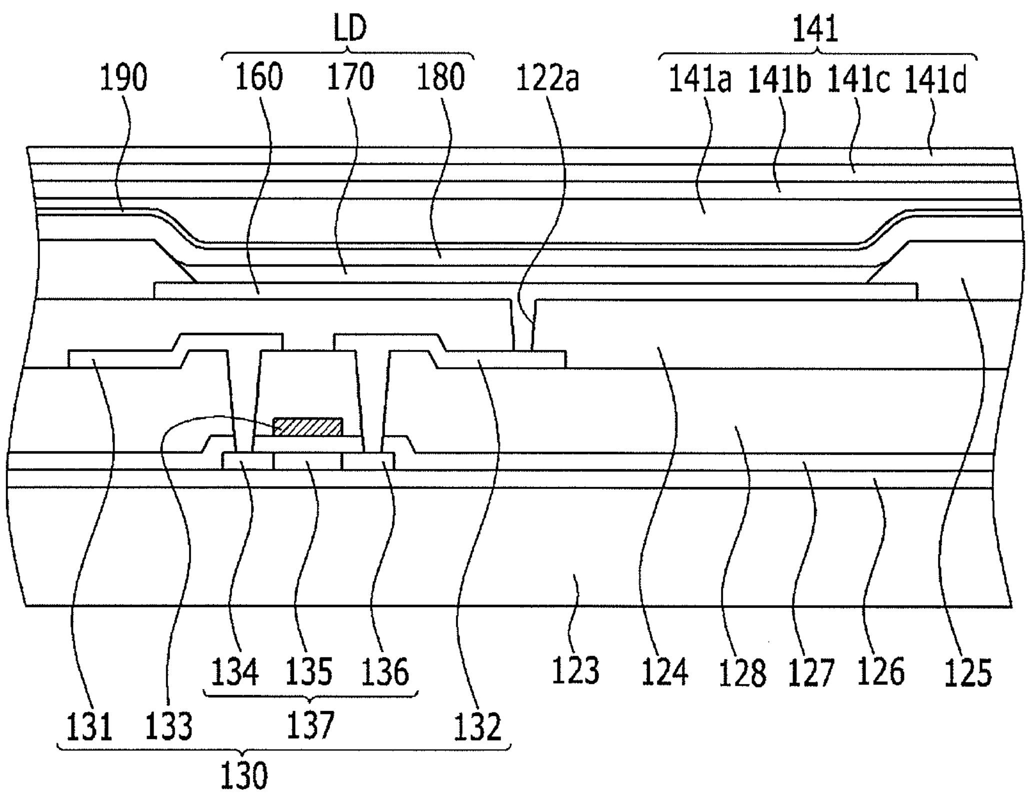
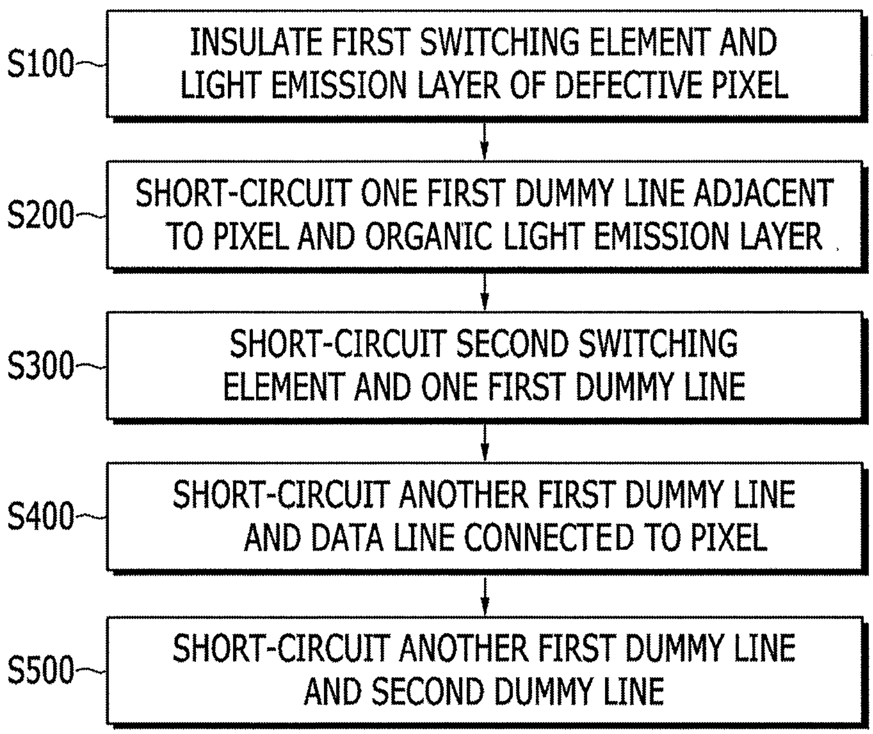

LD
141
190
160
170
180
122a
141a
141b
141c
141d
134
135
136
137
131
133
132
130
123
124
128
127
126
125

FIG. 7


S100
INSULATE FIRST SWITCHING ELEMENT AND LIGHT EMISSION LAYER OF DEFECTIVE PIXEL
S200
SHORT-CIRCUIT ONE FIRST DUMMY LINE ADJACENT TO PIXEL AND ORGANIC LIGHT EMISSION LAYER
S300
SHORT-CIRCUIT SECOND SWITCHING ELEMENT AND ONE FIRST DUMMY LINE
S400
SHORT-CIRCUIT ANOTHER FIRST DUMMY LINE AND DATA LINE CONNECTED TO PIXEL
S500
SHORT-CIRCUIT ANOTHER FIRST DUMMY LINE AND SECOND DUMMY LINE

ORGANIC LIGHT EMITTING DISPLAY DEVICE AND METHOD OF REPAIRING THE SAME

CROSS-REFERENCE TO RELATED APPLICATION

Korean Patent Application No. 10-2013-0112775, filed on Sep. 23, 2013, in the Korean Intellectual Property Office, and entitled: "Organic Light Emitting Display Device and Method Of Repairing The Same," is incorporated by reference herein in its entirety.

BACKGROUND

1. Field

The present disclosure relates to an organic light emitting display device and a repairing method thereof.

2. Description of the Related Art

Flat panel displays include, e.g., a liquid crystal display (LCD), a plasma display device (PDP), an organic light emitting diode (OLED) display, an electric field effect display (FED), and an electrophoretic display device. Among flat panel displays, the organic light emitting diode (OLED) display includes two electrodes and an organic emission layer disposed between the two electrodes, so electrons injected from one electrode and holes injected from the other electrode are combined in the organic emission layer to form excitons and emit light via energy generated from the excitons.

In the organic light emitting diode display, when an overcurrent larger than a normal current flows in some pixels due to characteristic deviations of elements included in each pixel, or due to disconnection or a short-circuit in a pixel circuit, such overcurrent may be converted into bright locations, generating pixel defects. In addition, various pixel defects, e.g., stains, may be generated due to inflow of foreign materials.

SUMMARY

A first exemplary embodiment provides an organic light emitting display device, including a substrate including a display area and a non-display area, a plurality of scan lines extended in a first direction on the substrate, a plurality of data lines extended in a second direction intersecting the first direction, a plurality of first switching elements in the display area, the plurality of first switching elements being connected to the scan lines and data lines, organic emission layers connected to the first switching elements, first dummy lines between corresponding adjacent ones of the plurality of scan lines, the first dummy lines extending in the first direction, second switching elements disposed in the non-display area, the second switching elements being adjacent to first ends of the first dummy lines, and second dummy lines extended in the second direction, the second dummy lines being adjacent to the second switching elements.

The organic light emitting display device may further include third switching elements disposed in the non-display area and adjacently formed at the other ends of the first dummy lines.

The organic light emitting display device may further include third dummy lines extended in the second direction and being adjacent to the third switching elements.

Each of the first switching elements may include: a switching thin film transistor configured to include a first source electrode, a first gate electrode, and a first drain electrode; and

a driving thin film transistor configured to include a second source electrode, a second gate electrode, and a second drain electrode, and each of the second switching elements may include: a switching thin film transistor configured to include a third source electrode, a third gate electrode, and a third drain electrode; and a driving thin film transistor configured to include a fourth source electrode, a fourth gate electrode, and a fourth drain electrode.

The first dummy lines may be overlapped with the second drain electrodes of the first switching elements.

The first dummy lines may be anode electrodes which connect the second drain electrodes to the organic emission layers.

The first dummy lines may be overlapped with fourth drain electrodes of the second switching element.

The first dummy lines may be overlapped with the data lines.

The first dummy lines may be overlapped with the second dummy lines.

The first dummy lines may be overlapped with the third dummy lines.

The first dummy lines may be formed of the same layer as that of the first to fourth gate electrodes.

The second dummy lines may be connected to the third source electrodes.

The second dummy lines may be formed of the same layer as that of the third source electrodes.

A second exemplary embodiment provides a repairing method of an organic light emitting display device that includes a plurality of intersecting scan and data lines, organic emission layers connected to first switching elements, and first dummy lines between corresponding adjacent ones of the plurality of scan lines and parallel thereto, the method including insulating a first switching element of an organic light emitting layer of a defective pixel from each other, the first switching element being connected to scan and data lines in a display area of a substrate, short-circuiting a first dummy line and the organic emission layer, the first dummy line being adjacent to the defective pixel, short-circuiting a second switching element and the first dummy line, the second switching element being disposed in parallel with the first switching element in a first direction, and the second switching element being in the non-display area adjacent to first ends of the first dummy lines, short-circuiting a second dummy line and the data line connected to the defective pixel, the second dummy line being adjacent to the first dummy line, and short-circuiting the second dummy line and a third dummy line, the second dummy lines being perpendicular to the first dummy lines and adjacent to the second switching elements.

Each of the first switching elements may include: a switching thin film transistor configured to include a first source electrode, a first gate electrode, and a first drain electrode; and a driving thin film transistor configured to include a second source electrode, a second gate electrode, and a second drain electrode, and each of the second switching elements may include: a switching thin film transistor configured to include a third source electrode, a third gate electrode, and a third drain electrode; and a driving thin film transistor configured to include a fourth source electrode, a fourth gate electrode, and a fourth drain electrode.

The insulating of the first switching element and the organic light emitting layer may include cutting off the second drain electrode of the first switching element.

The insulating of the first switching element and the organic light emitting layer may include cutting off an anode electrode located between the first drain electrode and the organic emission layer.

The short-circuiting of the pixel-adjacent first dummy line and the organic emission layer may include connecting the pixel-adjacent first dummy line to the second drain electrode.

The short-circuiting of the pixel-adjacent first dummy line and the organic emission layer may include connecting the pixel-adjacent first dummy line to an anode electrode.

The short-circuiting of the second switching element and the pixel-adjacent first dummy line may include connecting the fourth drain electrode of the second switching element to the pixel-adjacent first dummy line.

BRIEF DESCRIPTION OF THE DRAWINGS

Features will become apparent to those of ordinary skill in the art by describing in detail exemplary embodiments with reference to the attached drawings, in which:

FIG. **1** illustrates a schematic layout view of an organic light emitting display device in accordance with an exemplary embodiment.

FIG. **2** illustrates a schematic layout view of a repaired state of the organic light emitting display device shown in FIG. **1** in which a defective pixel is generated.

FIG. **3** illustrates a partial circuit diagram of the organic light emitting display device shown in FIG. **1**.

FIG. **4** illustrates a partial circuit diagram of a repaired state of the organic light emitting display device shown in FIG. **3**.

FIG. **5** illustrates an equivalent circuit diagram of a pixel of the organic light emitting display device in accordance with the present exemplary embodiment.

FIG. **6** illustrates a cross-sectional view of the organic light emitting display device in accordance with the present exemplary embodiment.

FIG. **7** illustrates a flowchart of a repairing method of the organic light emitting display device in accordance with the present exemplary embodiment.

DETAILED DESCRIPTION

Hereinafter, exemplary embodiments will be described in detail with reference to the attached drawings. As those skilled in the art would realize, the described embodiments may be modified in various different ways, all without limiting or departing from the spirit or scope of the present disclosure. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey exemplary implementations to those skilled in the art. The drawings and description are to be regarded as illustrative in nature and not restrictive. Like reference numerals designate like elements throughout the specification.

In addition, the size and thickness of each component shown in the drawings are shown for better understanding and ease of description, but the embodiments are not limited thereto. Further, in the drawings, the thickness of layers, films, panels, regions, etc., may be exaggerated for clarity. When a layer, a film, a plate, an element or the like is described as being arranged "on" or "over" another layer, film, plate, or element, this indicates that the layers, films, plates, or elements are arranged on or over each other directly or with a third layer, film, plate, or element intervening therebetween without the limitation to an upper side thereof on the basis of the gravity direction.

Further, throughout this specification, when a part is described as "comprising (or including)" constituent elements, this indicates that the part may further include other constituent elements unless particularly otherwise defined. Furthermore, when the first part is described as being arranged "on" the second part, this indicates that the first part is arranged at an upper side or a lower side of the second part without the limitation to the upper side thereof on the basis of the gravity direction.

Referring to FIG. **1** to FIG. **4**, an organic light emitting display device in accordance with an exemplary embodiment connects a defective pixel to a dummy element by using first to third dummy lines formed in a display area and a non-display area to repair the defective pixel.

The organic light emitting display device of the present exemplary embodiment may include a substrate, a plurality of scan lines **121**, a plurality of data lines **171**, first switching elements CR**1** to CR**3**, organic emission layers LD**1** to LD**3**, first dummy lines **100**, second switching elements CRD**1** to CRD**3**, and second and third dummy lines **171'** and **171"**.

The substrate may be formed of an insulating substrate made of, e.g., glass, quartz, ceramic, plastic, or the like, but is not limited thereto. For example, the substrate may be formed of a metal substrate, e.g., made of stainless steel or the like.

The substrate is divided into a display area II and non-display areas I and III. In the display area II, pixels for displaying images are located, while in the non-display areas I and III, drivers for driving the display area II to display images, and the like are located.

As shown in FIG. **1** to FIG. **4**, the first switching elements CR**1**, CR**2**, and CR**3**, the organic emission layers LD**1**, LD**2**, and LD**3**, the data lines **171**, and the first dummy line **100** are located in the display area II. The second and third dummy lines **171'** and **171"** are located in the non-display areas I and III. The first to third dummy lines **100**, **171'**, and **171"** are used to connect an organic emission layer to a second switching element of a defective pixel. This will be described in detail later.

The scan lines **121** may be extended in a first direction over the display and non-display areas I, II, and III to connect to the first and second switching elements CR**1** to CR**3** and CRD**1** to CRD**3**. For example, a scan line **121***a* of the scan lines **121** is connected to gate electrodes **270***a*, **280***a*, and **270***a*' of first through third switching elements CRD**1**, CR**1**, and CRD**1'**, respectively. Further, a connection part formed at one end of a scan line **121** may be connected to a gate driver.

The scan lines **121** may be formed of the same layer as the gate electrodes **270***a*, **270***a*', and **280***a*. Further, the scan lines **121** may be formed of the same material as the gate electrodes **270***a*, **270***a*', and **280***a*.

The data lines **171** may be extended in a second direction intersecting the first direction in the display area II. The data lines **171** may be extended to intersect the scan lines **121**, respectively. In this case, the data lines **171** are connected to the first switching elements CR**1** to CR**3**. In detail, the data lines **171** are connected to first source electrodes **220***a* to **220***c* of the first switching elements CR**1** to CR**3** to transfer data signals. Further, a connection part formed at one end of a data line **171** may be connected to a data driver.

The data lines **171** may be formed of the same layer as the first source electrodes **220***a* to **220***c*. Further, the data lines **171** may be formed of the same material as the first source electrodes **220***a* to **220***c*.

Referring to FIG. **3** and FIG. **4**, driving voltage lines **172'** and **172"** are extended in the second direction. The driving voltage line **172'** is located in the non-display area I, while the driving voltage line **172"** is located in the display area II. The driving voltage line **172'** is connected to fourth source electrodes **261***a* and **261***b* of the second switching elements

CRD1 and CRD2. The driving voltage line **172"** is connected to second source electrodes **221***a* and **221***b* of the first switching elements CR1 and CR2.

Each of the first switching elements CR1 to CR3 includes a switching thin film transistor and a driving thin film transistor. Herein, each of the first switching elements CR1 to CR3 may further include a storage capacitor Cst, e.g., the storage capacitor Cst may be any suitable capacitor and a detailed description thereof will be omitted.

The first switching elements CR1 to CR3 respectively drive organic emission layers LD1 to LD3 to be described later. Switching thin film transistors of the first switching elements CR1 to CR3 respectively include first source electrodes **220***a*, **220***b*, and **220***c*, first gate electrodes **280***a*, **280***b*, and **280***c*, and first drain electrodes. As described above, first source electrodes **220***a* to **220***c* are connected to the data line **171**. The first gate electrodes **280***a* to **280***c* of the switching thin film transistors are connected to the scan line **121**.

Each driving thin film transistor of the first switching elements CR1 to CR3 includes a second source electrode, a second gate electrode, and a second drain electrode. The driving thin film transistors of the first switching elements CR1 to CR3 may be connected to the organic emission layers LD1 to LD3. As shown in FIG. **2** to FIG. **5**, members indicated by reference numerals **240***a*, **240***b*, and **240***c*, which connect the organic emission layers LD1 to LD3 to the first switching elements CR1 to CR3, may respectively be second drain electrodes of the anode or driving thin film transistors. The reference numerals **240***a* to **240***c* respectively indicate cut-off areas between the first switching elements CR1 to CR3 and the organic emission layers LD1 to LD3 in the repairing method of an organic light emitting display device in accordance with the present exemplary embodiment. This will be described in detail later.

As shown in FIG. **1** to FIG. **4**, members indicated by reference numerals **210***a*, **210***b*, and **210***c*, which overlap with the first dummy lines **100**, may respectively be anode electrodes or second drain electrodes. In other words, the first dummy lines **100** may overlap with the anode electrodes or the second drain electrodes in the repairing method of an organic light emitting display device in accordance with the present exemplary embodiment. This will also be described in detail later.

The organic emission layers LD1 to LD3 connected to the first switching elements CR1 to CR3 are formed of a low molecular organic material or a high molecular organic material. Each of the organic emission layers LD1 to LD3 may be formed of a multilayer that includes the emission layer and at least one of a hole injection layer (HIL), a hole transport layer (HTL), an electron transport layer (ETL), and an electron injection layer (EIL). When all of the above layers are included, the HIL is disposed on the anode electrode, and the HTL, the emission layer, the ETL, and the EIL are sequentially layered thereon. The organic emission layers LD1 to LD3 are identified as colors, e.g., red, green, blue, and the like, according to material types thereof.

The first dummy lines **100** may be extended in the first direction. The first dummy lines **100** may be formed to extend over the display areas II and the non-display areas I and III on the substrate. The first dummy lines **100** may be used to connect defective pixels to dummy elements, i.e., to the second or third switching elements CRD1 to CRD3 or CRD1' to CRD3'.

Each of the first dummy lines **100** may be disposed between corresponding adjacent scan lines **121**. For example, a first dummy line **100***a* is located between the scan line **121***a* and an adjacent scan line **121***b*. Similarly, a first dummy line **100***b* is located between the scan line **121***b* and an adjacent scan line **121***c*.

The first dummy lines **100** are overlapped with the data lines **171**. In this case, the first dummy lines **100** and the data lines **171** which are overlapped with each other may be connected to each other in the repairing operation of the defective pixel.

Further, as described above, the first dummy lines **100** may be overlapped with the members indicated by the reference numerals **210***a* to **210***c*. In the present exemplary embodiment, the reference numerals **210***a* to **210***c* may indicate the anode electrodes or the second drain electrodes. Further, the first dummy lines **100** and the members indicated by the reference numerals **210***a* to **210***c* which are overlapped with each other may be connected to each other in the repairing operation of the defective pixel.

The first dummy lines **100** are also overlapped with fourth drain electrodes **230***a* to **230***c* of the second switching elements CRD1 to CRD3 to be described later. In addition, the first dummy lines **100** are overlapped with the second and third dummy lines **171'** and **171"** to be described later in the non-display area I. The second dummy lines **171'** or the third dummy lines **171"** may be connected with the first dummy lines **100** in the repairing operation of the defective pixel.

In the meantime, the first dummy lines **100** may be formed of the same layer as that of gate electrodes of the first and second switching elements CR1 to CR3 and CRD1 to CRD3. In this case, the first dummy lines **100** may be made of the same material as that of the gate electrodes.

Referring to FIG. **1** to FIG. **4**, the second switching elements CRD1 to CRD3 are located in the non-display area I. The second switching elements CRD1 to CRD3 may serve as dummy elements to be connected to the organic emission layer LD1 to LD3 instead of the first switching element CR1 to CR3 of a defective pixel. In this case, each of the second switching elements CRD1 to CRD3 includes a switching thin film transistor and a driving thin film transistor. Each of the second switching elements CRD1 to CRD3 may further include a storage capacitor Cst-Da or Cst-Db. The detailed description thereof will be omitted.

The switching thin film transistors of the second switching elements CDR1 to CRD3 respectively include third source electrodes **260***a*, **260***b*, and **260***c*, third gate electrodes **270***a*, **270***b*, and **270***c*, and third drain electrodes. The third source electrodes **260***a* to **260***c* are connected to the second dummy lines **171'** to be described later. The third gate electrodes **270***a* to **270***c* are connected to the scan lines **121**.

Referring to FIG. **3** and FIG. **4**, the driving thin film transistors of the second switching elements CDR1 to CRD3 include the fourth source electrodes **261***a* and **261***b*, fourth gate electrodes, and the fourth drain electrodes **230***a* and **230***b*. As described above, the fourth drain electrodes **230***a* and **230***b* are overlapped with the first dummy lines **100**. The fourth source electrodes **261***a* and **261***b* are connected to the driving voltage line **172'**.

The second dummy lines **171'** are formed to extend in the second direction in the non-display area I. In this case, the second dummy lines **171'** are located adjacent to the second switching elements CRD1, CRD2, and CRD3. The second dummy lines **171'** are connected to the third source electrodes **260***a*, **260***b*, and **260***c* of the second switching elements CRD1, CRD2, and CRD3 in the non-display area I.

The second dummy lines **171'** may be formed of the same layer as that of third source electrodes **260***a*, **260***b*, and **260***c*.

Further, the second dummy lines **171'** may be made of the same material as that of the third source electrodes **260***a*, **260***b*, and **260***c*.

In the meantime, referring to FIG. **1** and FIG. **2**, the third dummy lines **171"** and the third switching elements CRD**1'**, CRD**2'**, and CRD**3'** may be located in the non-display area III. In this case, the third dummy lines **171"** and third switching elements CRD**1'**, CRD**2'**, and CRD**3'** respectively correspond to the second dummy lines **171'** and the second switching elements CRD**1**, CRD**2**, and CRD**3** in the non-display area I. In other words, since the third dummy lines **171"** and the third switching elements CRD**1'**, CRD**2'**, and CRD**3'** respectively perform the same functions as those of the second dummy line **171'** and second switching elements CRD**1**, CDRD**2**, and CRD**3**, the detailed description thereof will be omitted.

The repairing method of an organic light emitting display device in accordance with the exemplary embodiment will now be described with reference to FIGS. **1**-**4** and FIG. **7**. In the present exemplary embodiment, it is assumed that a defect is generated in a pixel including the first switching element CR**1** and the organic emission layer LD**1** of the display area I.

First, in a defective pixel, the first switching element CR**1** is insulated from the organic emission layer LD**1** (S**100**).

As shown in FIGS. **2** and **4**, member **240***a*, which connects the first switching element CR**1** to the organic emission layer LD**1**, is cut off. As described above, in the present exemplary embodiment, the member **240***a* may be the anode electrode or the second drain electrode. As the anode electrode or the second drain electrode is cut off, a current supplied to the organic emission layer LD**1** can be blocked.

In the repairing method of an organic light emitting display device in accordance with the present exemplary embodiment, a laser device may be used to cut off a specific electrode or to connect a plurality of electrodes or layers. However, embodiments are not limited to cutting-off by a laser and any other suitable method of cutting-off or connecting in a typical manufacturing or repairing process of a display device may be applied thereto without being limited to the laser device.

Next, the organic emission layer LD**1** and the first dummy line **100***a* adjacent to a defective layer among the plurality of first dummy lines **100** are short-circuited (S**200**).

Referring to FIG. **2** and FIG. **4**, the first dummy line **100***a* is connected to the member **210***a* to short-circuit the first dummy line **100***a* and the organic emission layer LD**1**. In other words, the first dummy line **100***a* and the member **210***a* are connected to each other at a first location A at which they are overlapped with other. As described above, the member **210***a* may be the anode electrode or the second drain electrode, so the first dummy line **100***a* can be connected to the anode electrode or the second drain electrode.

Next, the first dummy line **100***a* and the second switching element CRD**1** serving as the dummy element are short-circuited (S**300**). Herein, the second switching element CRD**1** is a second switching element disposed in the first direction in parallel with the first switching element CR**1** of the defective pixel.

The first dummy line **100***a* and the fourth drain electrode **230***a* are connected to each other when the first dummy line **100***a* and the second switching element CRD**1** are short-circuited, i.e., in operation S**300**. As described above, the fourth drain electrode **230***a* of the second switching element CRD**1** and the first dummy line **100***a* are overlapped with each other and connected to each other at a second location B. In other words, at the second location B, the first dummy line **100***a* and the fourth drain electrode **230***a* are connected to each other.

Next, the first dummy line **100***b* adjacent to the first dummy line **100***a* and the data line **171** are short-circuited (S**400**). The data line **171** intersects the first dummy line **100***b* at a third location C at which they are overlapped with each other. In other words, at the third location C, the data line **171** is connected to the first dummy line **100***a*.

Next, the first dummy line **100***b* and the second dummy line **171'** are short-circuited (S**500**). The second dummy line **171'** is adjacent to the second switching element CRD**1**, and extends in the second direction in the non-display area I. In this case, the first dummy line **100***b* and the second dummy line **171'** intersect each other at a fourth location D in the non-display area I. Accordingly, the first dummy line **100***b* and the second dummy line **171'** are connected to each other at the fourth location D.

As described above, it is possible to repair the defective pixel by short-circuiting the first dummy lines **100***a* and **100***b*, the second dummy line **171'** and the data line **171**. In brief, a defective first switching element CR**1** is separated from the organic emission layer LD**1**, and the second switching element CRD**1** is connected to the organic emission layer LD**1** via a portion of the first dummy lines **100***a*. As a result, current flows from the second switching element CRD**1** to the organic emission layer LD**1**. Further, a data signal transmitted to the defective first switching element CR**1** is also transferred to the second switching element CRD**1** through the data line **171**, the first dummy line **100***b*, and the second dummy line **171**.'

In the repairing method of an organic light emitting display device in accordance with the present exemplary embodiment, the order of the short-circuiting steps S**200** to S**500** may be varied.

FIG. **5** illustrates an equivalent circuit diagram showing a pixel of the organic light emitting display device in accordance with the present exemplary embodiment. FIG. **6** illustrates a cross-sectional view showing the organic light emitting display device in accordance with the present exemplary embodiment.

Hereinafter, the cross-section and the circuit diagram of one pixel of the organic light emitting display device in accordance with the present exemplary embodiment will be described with reference to FIG. **5** and FIG. **6**. However, the present exemplary embodiment can be applied to pixels having various structures without being limited to the structure shown in FIG. **5** and FIG. **6**.

Referring to FIG. **5**, an organic light emitting display device includes the plurality of signal lines **121**, **171**, and **172**, and a pixel PX connected thereto. The pixel PX may be any one of a red pixel R, a green pixel G, and a blue pixel B.

The signal lines include scanning signal lines **121** for transmitting gate signals (or scan signals), data lines **171** for transmitting data signals, and driving voltage lines **172** for transmitting driving voltage. The scan signal lines **121** are substantially extended in a row direction and are substantially parallel with each other, and the data lines **171** are substantially extended in a column direction and are substantially parallel with each other. The driving voltage lines **172** are shown to be substantially extended in a column direction, but they can be extended in the row direction or the column direction or formed as a mesh net, e.g., in a grid pattern.

One pixel PX includes a switching transistor T**1**, a driving transistor T**2**, a storage capacitor Cst, and an organic light emitting element LD. Although not shown in the drawing, the pixel PX may further include a thin film transistor and capacitor so as to compensate the current supplied to the organic light emitting element.

The switching transistor T**1** includes a control terminal N**1**, an input terminal N**2**, and an output terminal N**3**, and the control terminal N**1** is connected to the scan signal line **121**, the input terminal N**2** is connected to the data line **171**, and the output terminal N**3** is connected to the driving transistor T**2**. The switching transistor T**1** transmits the data signal provided by the data line **171** to the driving transistor T**2** in response to the scan signal provided by the scan signal line **121**.

The driving transistor T**2** includes a control terminal N**3**, an input terminal N**4**, and an output terminal N**5**, and the control terminal N**3** is connected to the switching transistor T**1**, the input terminal N**4** is connected to the driving voltage line **172**, and the output terminal N**5** is connected to the organic light emitting element LD. The driving transistor T**2** outputs an output current Id that is variable by a voltage between the control terminal N**3** and the output terminal N**5**.

The capacitor Cst is connected between the control terminal N**3** and the input terminal N**4** of the driving transistor T**2**. The capacitor Cst charges the data signal applied to the control terminal N**3** of the driving transistor T**2** and maintains the charge when the switching transistor T**1** is turned off.

The organic light emitting element LD is exemplarily an organic light emitting diode (OLED), and includes an anode connected to the output terminal N**5** of the driving transistor T**2** and a cathode connected to the voltage Vss. The organic light emitting element LD displays an image by emitting light with different intensities depending on the output current Id of the driving transistor T**2**.

The organic light emitting element LD may include an organic material for emitting one or at least one of primary colors (i.e., red, green and blue), and the organic light emitting device displays the desired image by a spatial sum of the colors.

The switching transistor T**1** and the driving transistor T**2** are n-channel field effect transistors (FETs), and at least one of them may be a p-channel field effect transistor. Also, the connection between the transistors T**1** and T**2**, the capacitor Cst, and the organic light emitting element LD is changeable.

Hereinafter, the organic light emitting display device of the present exemplary embodiment will be described with reference to the cross-section thereof shown in FIG. **6**.

Referring to FIG. **6**, a substrate **123** may be formed as an insulating substrate, e.g., made of glass, quartz, ceramic, plastic, and the like. However, embodiments are not limited thereto, and the substrate **123** may also be formed as a metallic substrate, e.g., made of stainless steel and the like.

A buffer layer **126** is formed on the substrate **123**. The buffer layer **126** serves to prevent penetration of impurity elements and to planarize the surface of the substrate **123**. The buffer layer **126** may be formed of various materials capable of performing the above-mentioned functions. As an example, one of a silicon nitride (SiN_x) layer, a silicon oxide (SiO_x) layer, and a silicon oxynitride (SiO_xN_y) layer may be employed as the buffer layer **126**. However, the buffer layer **126** may be omitted according to type and process conditions of the substrate **123**.

A driving semiconductor layer **137** may be formed on the buffer layer **126**. The driving semiconductor layer **137** may be formed of a polysilicon film. The driving semiconductor layer **137** includes a channel region **135** in which impurities are not doped, and a source region **134** and a drain region **136** which are doped and formed at opposite sides of the channel region **135**. In this case, the ionic material to be doped is a p-type impurity, e.g., boron (B) or B_2H_6. In this case, the impurity may be changed according to a kind of the thin film transistor.

A gate insulating layer **127**, e.g., formed of a silicon nitride (SiN_x) or a silicon oxide (SiO_x), is formed on the driving semiconductor layer **137**. A gate wire including a driving gate electrode **133** is formed on the gate insulating layer **127**. In addition, the driving gate electrode **133** is formed to be overlapped with at least a part of the driving semiconductor layer **137**, e.g., the channel region **135**.

An interlayer insulating layer **128** covering the driving gate electrode **133** is formed on the gate insulating layer **127**. Through holes exposing the source region **134** and the drain region **136** of the driving semiconductor layer **137** are formed in the gate insulating layer **127** and the interlayer insulating layer **128**. The interlayer insulating layer **128** may be formed by using a ceramic-series material, e.g., silicon nitride (SiN_x), silicon oxide (SiO_x), or the like, similar to the gate insulating layer **127**.

A data wire including a driving source electrode **131** and a driving drain electrode **132** is formed on the interlayer insulating layer **128**. In addition, the driving source electrode **131** and the driving drain electrode **132** are respectively connected to the source region **134** and the drain region **136** of the driving semiconductor layer **137** via through holes formed in the interlayer insulating layer **128** and the gate insulating layer **127**.

As such, a driving thin film transistor **130** including the driving semiconductor layer **137**, the driving gate electrode **133**, the driving source electrode **131**, and the driving drain electrode **132** is formed. The configuration of the driving thin film transistor **130** is not limited to the above-described examples, and may be variously changed into any suitable configuration.

A planarization layer **124** covering the data wire is formed on the interlayer insulating layer **128**. The planarization layer **124** serves to planarize the interlayer insulating layer **128** by eliminating steps in order to increase the light emitting efficiency of the organic light emitting element to be formed thereon. In addition, the planarization layer **124** has an electrode contact hole **122***a* exposing a part of the drain electrode **132**. The planarization layer **124** may be made of, e.g., at least one material of polyacrylate resin, epoxy resin, phenolic resin, polyamide resin, polyimide resin, unsaturated polyester resin, polyphenylene ether resin, polyphenylene sulfide resin, and benzocyclobutene (BCB). This exemplary embodiment is not limited to the above-described configuration, e.g., the planarization layer **124** and/or the interlayer insulating layer **128** may be omitted in some cases.

A pixel electrode **160** serving as a first electrode of the organic light emitting element is formed on the planarization layer **124**. In other words, the organic light emitting display device includes a plurality of pixel electrodes **160** respectively disposed for a plurality of pixels. Herein, the pixel electrodes **160** are separated from each other. Each of the pixel electrodes **160** is connected to the drain electrode **132** through an electrode contact hole **122***a* of the planarization layer **124**.

Further, a pixel defining layer **125** having an opening that exposes the pixel electrode **160** is formed on the planarization layer **124**. That is, the pixel defining layer **125** has a plurality of openings that are individually formed for each pixel. An organic emission layer **170** may be formed for each opening formed by the pixel defining layer **125**. Accordingly, a pixel region in which each organic emission layer is formed may be defined by the pixel defining layer **125**.

In this case, the first electrode **160** is disposed so as to correspond to the opening of the pixel defining layer **125**. However, the pixel electrode **160** is not necessarily disposed in the opening of the pixel defining layer **125**. The pixel electrode **160** may be disposed beneath the pixel defining layer **125** in such a way so as to be partially overlapped by the pixel defining layer **125**. The pixel defining layer **125** may be made of, e.g., a resin such as polyacrylate resin, polyimide resin, or the like, or a silica-series inorganic material.

Meanwhile, the organic emission layer **170** is formed on the pixel electrode **160**. Further, a common electrode **180** serving as a second electrode of the organic light emitting element may be formed on the organic emission layer **170**. As such, the organic light emitting element LD including the pixel electrode **160**, the organic emission layer **170**, and the common electrode **180** is formed.

Each of the pixel electrode **160** and the common electrode **180** may be formed of a transparent conductive material, or a semitransparent or reflective conductive material. The OLED display may be a top emission type, a bottom emission type, or a both-side emission type according to a kind of the material of the pixel electrode **160** and the common electrode **180**.

A cover film **190** covering the common electrode **180** may be formed of an organic film on the common electrode **180**, e.g., to protect the common electrode **180**. Further, a thin film encapsulation layer **141** is formed on the cover layer **190**. The thin film encapsulation layer **141** seals and protects the organic light emitting element LD and a driving circuit portion formed on the substrate **123** from the outside.

The thin film encapsulation layer **141** includes organic encapsulation layers **141***a* and **141***c* and inorganic encapsulation layers **141***b* and **141***d* alternately laminated one by one. FIG. **6** illustrates a case where the two organic encapsulation layers **141***a* and **141***c* and the two inorganic encapsulation layers **141***b* and **141***d* are alternately stacked one by one to constitute the thin film encapsulation layer **141** as an example, but it is not limited thereto.

According to a repairing method of an organic light emitting display device in accordance with the exemplary embodiments, it is possible to simplify a recovery of a defective pixel in the organic light emitting display device by short-circuiting and insulating operations of multiple overlapped layers. That is, it is possible to simplify repair of a defective pixel in the organic light emitting display device by using first to third dummy lines to connect a dummy element located in a non-display area to an organic emission layer of the defective pixel, e.g., without removing portions of the dummy lines.

Example embodiments have been disclosed herein, and although specific terms are employed, they are used and are to be interpreted in a generic and descriptive sense only and not for purpose of limitation. In some instances, as would be apparent to one of ordinary skill in the art as of the filing of the present application, features, characteristics, and/or elements described in connection with a particular embodiment may be used singly or in combination with features, characteristics, and/or elements described in connection with other embodiments unless otherwise specifically indicated. Accordingly, it will be understood by those of skill in the art that various changes in form and details may be made without departing from the spirit and scope of the present invention as set forth in the following claims.

What is claimed is:

1. An organic light emitting display device, comprising:

a substrate including a display area and a non-display area;

a plurality of scan lines extended in a first direction on the substrate;

a plurality of data lines extended in a second direction intersecting the first direction;

a plurality of first switching elements in the display area, the plurality of first switching elements being connected to the scan lines and data lines;

organic emission layers connected to the first switching elements;

first dummy lines between corresponding adjacent ones of the plurality of scan lines, the first dummy lines extending in the first direction;

second switching elements disposed in the non-display area, the second switching elements being adjacent to first ends of the first dummy lines; and

second dummy lines extended in the second direction, the second dummy lines being adjacent to the second switching elements.

2. The organic light emitting display device as claimed in claim **1**, further comprising third switching elements in the non-display area, the third switching elements being adjacent to second ends of the first dummy lines.

3. The organic light emitting display device as claimed in claim **2**, further comprising third dummy lines extended in the second direction, the third dummy lines being adjacent to the third switching elements.

4. The organic light emitting display device as claimed in claim **3**, wherein the first dummy lines are overlapped with the third dummy lines.

5. The organic light emitting display device as claimed in claim **1**,

wherein: each of the first switching elements includes:

a switching thin film transistor including a first source electrode, a first gate electrode, and a first drain electrode; and

a driving thin film transistor including a second source electrode, a second gate electrode, and a second drain electrode, and

wherein each of the second switching elements includes:

a switching thin film transistor including a third source electrode, a third gate electrode, and a third drain electrode; and

a driving thin film transistor including a fourth source electrode, a fourth gate electrode, and a fourth drain electrode.

6. The organic light emitting display device as claimed in claim **5**, wherein the first dummy lines overlap the second drain electrodes of the first switching elements.

7. The organic light emitting display device as claimed in claim **5**, wherein the first dummy lines overlap anode electrodes which connect the second drain electrodes to the organic emission layers.

8. The organic light emitting display device as claimed in claim **5**, wherein the first dummy lines overlap fourth drain electrodes of the second switching element.

9. The organic light emitting display device as claimed in claim **5**, wherein the first dummy lines are in a same layer as the first to fourth gate electrodes.

10. The organic light emitting display device as claimed in claim **9**, wherein the second dummy lines are connected to the third source electrodes.

11. The organic light emitting display device as claimed in claim **10**, wherein the second dummy lines are in a same layer as the third source electrodes.

12. The organic light emitting display device as claimed in claim **1**, wherein the first dummy lines overlap the data lines.

13. The organic light emitting display device as claimed in claim **1**, wherein the first dummy lines overlap the second dummy lines.

14. A repairing method of an organic light emitting display device that includes a plurality of intersecting scan and data lines, organic emission layers connected to first switching elements, and first dummy lines between corresponding adjacent ones of the plurality of scan lines and parallel thereto, the method comprising:

insulating a first switching element of an organic light emitting layer of a defective pixel from each other, the first switching element being connected to scan and data lines in a display area of a substrate;

short-circuiting a first dummy line and the organic emission layer, the first dummy line being adjacent to the defective pixel;

short-circuiting a second switching element and the first dummy line, the second switching element being disposed in parallel with the first switching element in a first direction, and the second switching element being in the non-display area adjacent to first ends of the first dummy lines;

short-circuiting a second dummy line and the data line connected to the defective pixel, the second dummy line being adjacent to the first dummy line; and

short-circuiting the second dummy line and a third dummy line, the second dummy lines being perpendicular to the first dummy lines and adjacent to the second switching elements.

15. The repairing method as claimed in claim **14**, wherein:

each of the first switching elements includes:

a switching thin film transistor including a first source electrode, a first gate electrode, and a first drain electrode; and

a driving thin film transistor including a second source electrode, a second gate electrode, and a second drain electrode, and

wherein each of the second switching elements includes:

a switching thin film transistor including a third source electrode, a third gate electrode, and a third drain electrode; and

a driving thin film transistor including a fourth source electrode, a fourth gate electrode, and a fourth drain electrode.

16. The repairing method as claimed in claim **15**, wherein insulating the first switching element and the organic light emitting layer includes cutting off the second drain electrode of the first switching element.

17. The repairing method as claimed in claim **15**, wherein insulating the first switching element and the organic light emitting layer includes cutting off an anode electrode located between the first drain electrode and the organic emission layer.

18. The repairing method as claimed in claim **15**, wherein short-circuiting the first dummy line and the organic emission layer includes connecting the first dummy line to the second drain electrode.

19. The repairing method as claimed in claim **15**, wherein short-circuiting the first dummy line and the organic emission layer includes connecting the first dummy line to an anode electrode.

20. The repairing method as claimed in claim **15**, wherein short-circuiting the second switching element and the first dummy line includes connecting the fourth drain electrode of the second switching element to the first dummy line.

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